Atmospheric Chemistry and Physics Discussions

Atmos. Chem. Phys. Discuss., referee comment RC2
https://doi.org/10.5194/acp-2020-1291-RC2, 2021

Comment on acp-2020-1291

Anonymous Referee #2

Referee comment on "Improving predictability of high-ozone episodes through dynamic boundary conditions, emission refresh and chemical data assimilation during the Long Island Sound Tropospheric Ozone Study (LISTOS) field campaign" by Siqi Ma et al., Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2020-1291-RC2, 2021

Synopsys:

An air quality forecasting system is used in a limited domain surrounding the Long Island Sound (LIS) to predict ozone and PM concentrations for a week (August 25-31, 2018) during the LIS Tropospheric Ozone Study (LISTOS). The model has 3-km horizontal grid resolution, which is high resolution compared to the 12-km of the National Air Quality Forecast Capability (NAQFC). A performance evaluation is performed using routine air quality observations during the week to compare three different options with the model. The first one is static default boundary conditions versus dynamic boundary conditions obtained from NAQFC over a larger domain. The second is a test with different variations of the optimal interpolation method applied to the initial conditions. The third and last option is emissions adjustment which is applied either uniformly, domain wide or differently in four urban subdomains. The options that perform better than the others are adopted. The performance evaluation is repeated with these options combined. Finally, the model predictions are evaluated against NO_2 vertical column density measured by an airborne spectrometer/radiometer and O_3 profiles measured by a ground-based LIDAR during LISTOS.

General Comments:

- Using static boundary conditions (BCs) is not a viable option for a small, polluted domain with well acknowledged transport impacts such as the northeastern US. Therefore, the results of applying static BCs are not interesting or useful. As expected, the model performs very poorly with static BCs. The discussion of this unviable option takes up unnecessary space and distracts the reader's attention up until the very end. The trivial conclusion that switching from static to dynamic BCs significantly improves ozone predictability undermines other (and in my view) more important improvements. I recommend removing the discussion of static boundary conditions from the main text.

Including it as a supplement might be beneficial for novice readers.

- The rationale for using different variations of optimal interpolation (OI) could be presented better. The reader may not be familiar with the OI method and its strengths/weaknesses. Therefore, there should be a short discussion of the expectations with each alternative. The fact that the control case is no initial condition adjustment should be stated upfront otherwise the reader may think that the control is still the static boundary condition. The discussion of the performance with the inverse distance weighting option is insufficient or missing.
- I disagree with the choice of the domain-average emission adjustment based on performance. The NO_x emission differences between the base year (2011) and current year (2018) are so different for the four subdomains that averaging them cannot be justified. The subdomain emission adjustment is clearly the right choice because it provides the model with the right information. The better performance with the domain-average emission adjustment here is a typical case of getting the "right" answer for the wrong reason. I recommend a more detailed, site specific analysis of performance with these two adjustment methods. I expect at least the NO_2 performance of the subdomain adjustment to be better at the sites in an around those subdomains.
- Section 4 should include the comparisons of NO_2 column and O_3 profile measurements during LISTOS with the model using the subdomain emission adjustment.

Specific Comments:

Please see the attached annotated PDF file for specific comments.

Please also note the supplement to this comment:
https://acp.copernicus.org/preprints/acp-2020-1291/acp-2020-1291-RC2-supplement.pdf